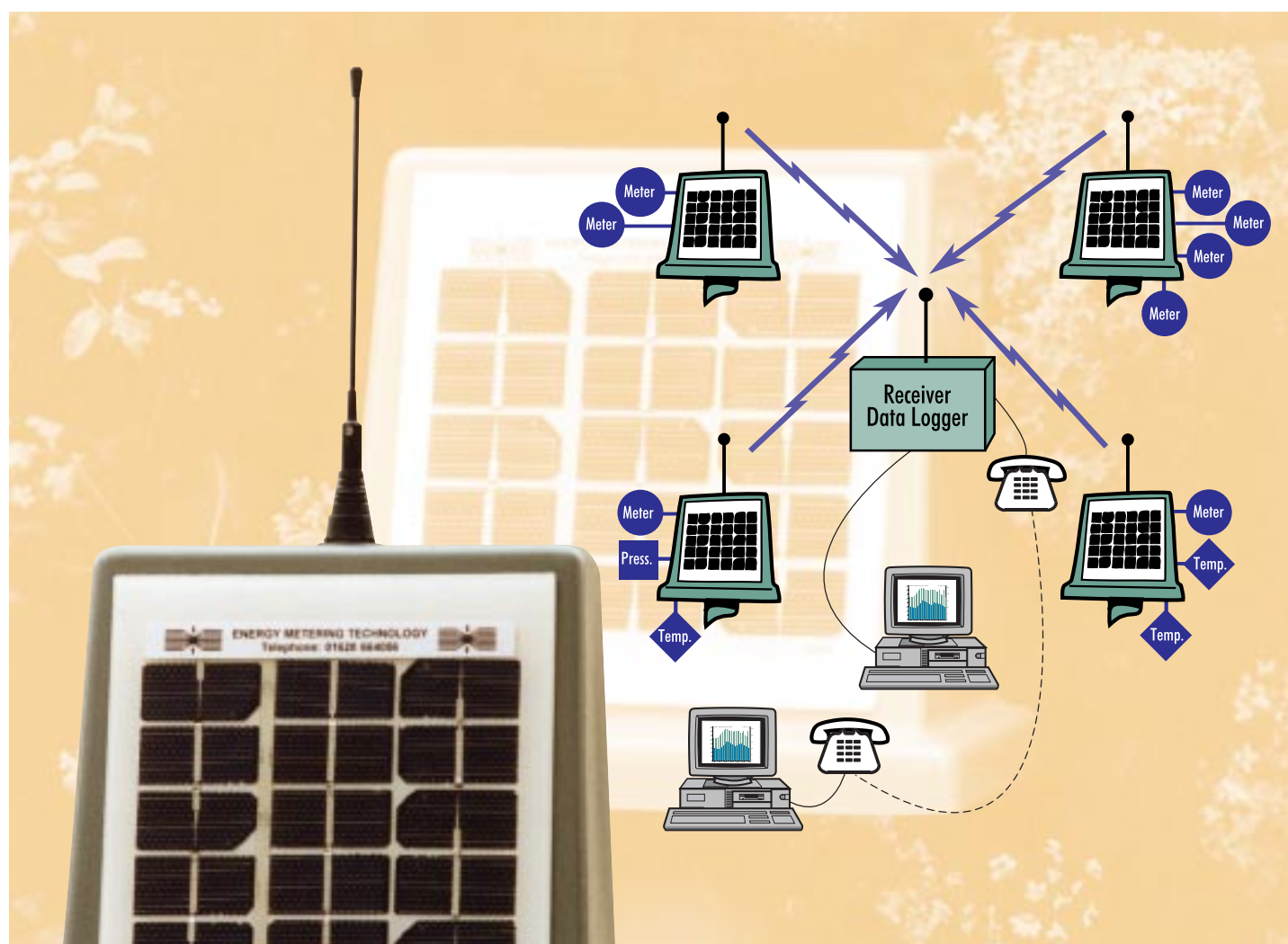


Low-cost automatic meter-reading system – using low-power radio



ENERGY EFFICIENCY

INTRODUCTION



Organisations that implement effective energy management strategies typically save 20% or more of their fuel costs. Part of any energy management strategy includes an accurate and reliable method for monitoring energy, fuel and water consumption.

Automating both meter reading and meter data analysis effectively provides continuous 'real time' monitoring of utility consumption and costs. Further automatic monitoring

and targeting (M&T) analysis, where consumptions are audited against a target or 'consumption signature', enables exceptional consumptions to be automatically identified and reported, thereby allowing rapid action to be taken to stem wastage.

With a real-time automatic meter-reading system and appropriate proprietary 'off the shelf' M&T software, the whole process can be fully automated, providing the busy manager with reports only when something needs rectifying.

In the past there has been a barrier to the installation of automatic meter-reading systems because they relied on costly hard wiring. However,

this General Information Leaflet (GIL) describes a novel approach to automating the remote reading of meters. The system (DATA BIRD) uses low-power radio to automatically transmit meter readings to a central receiver/data logger, thus avoiding the need for conventional hard wiring. The meter-reading data can then be automatically downloaded from the receiver/data logger to a standard personal computer (PC) where appropriate M&T software can fully and automatically analyse the data. Alternatively, the data can be downloaded into an existing building energy management system (BEMS).

Although the use of radio for transmitting fuel and energy consumption data is not new, it is only with the deregulation of part of the radio frequency (RF) spectrum that unlicensed commercial use has made the technology available at low cost, to a much broader range of users.

The DATA BIRD system was developed with assistance from the Department of the Environment, Transport and the Regions' (DETR's) Energy Efficiency Best Practice programme (see box).

This GIL is written primarily for individuals with responsibility for managing energy, fuel and water consumption in sites where the reading of multiple meters presents practical problems. Case studies illustrate how the DATA BIRD system has helped to achieve significant savings. Contact details for further information are included on the back page.

DATA BIRD

DETR provided financial support and practical advice for the development of DATA BIRD. BRECSU was responsible for managing the project on behalf of DETR as part of the Energy Efficiency Best Practice programme.

The project was split into four phases.

- **Phase 1: System design.** This included identifying suitable test sites and developing the system specification.
- **Phase 2: Hardware development.** This involved evaluating and testing receiver and transmitter systems, as well as investigating encoding and decoding systems.

- **Phase 3: Software development.** This included writing data-gathering routines and enhancing the proprietary M&T software package.
- **Phase 4: System testing.** In this phase the system was installed on two sites and tested over a six-month period.

Although each of the four phases were of equal importance, this GIL describes only the fourth phase.

FEATURES AND BENEFITS

MONITORING AND TARGETING SYSTEMS

Conventional M&T systems within larger enterprises tend to rely on sophisticated building energy monitoring systems and qualified energy management staff to interpret data and implement energy efficiency measures. M&T systems for smaller organisations are available as 'packaged software solutions' for running on a single PC.

What all M&T systems have in common is the need for a regular reading of meters. The development of a low-cost automatic meter-reading system that is simple to install offers a realistic solution to the energy management needs of both large and small energy consumers.

A TYPICAL SYSTEM

A typical DATA BIRD system configuration is shown in figure 1. A link to a PC requires an appropriate communications software program to convert the data into files for importing into an M&T software package.

The transmitter is available either as a mains-operated or solar-charged battery unit.

The solar-charged battery version of the transmitter is extremely flexible. It can be mounted almost anywhere; on the side of a building or on a pole by the roadside, adjacent to the meter being monitored. The transmitter aerial can be mounted either externally or internally within the transmitter housing. The solar panel requires only a low level of light to recharge the battery, which is designed to operate for 28 days in total darkness. The mains-operated version of the transmitter can be housed within the meter cupboard, with no reduction in quality of the received signal.

Each transmitter can accept the digital outputs from up to eight meters and two analogue channels such as temperature and pressure. The transmission techniques employed are well proven and widely adopted for this type of application.

The mains-operated receiver is capable of receiving the readings of up to 2000 meters. The receiver can be accommodated wherever convenient – usually in the same office as the PC running the M&T software program. A proprietary modem permits interrogation over a telephone line, thereby allowing several sites or buildings to be monitored from a remote point. This arrangement makes DATA BIRD attractive for an energy monitoring bureau service arrangement.

BENEFITS

- The use of radio minimises wiring costs.
- The wave band utilised requires no radio licence in the UK.
- The system has an operating range of up to 10 km.
- The transmitter can be mounted almost anywhere.
- The transmitter is housed in a vandal-proof reinforced-steel box.
- Multiple receivers are possible, making the data available at any location.
- The system integrates with a wide range of M&T software programs.

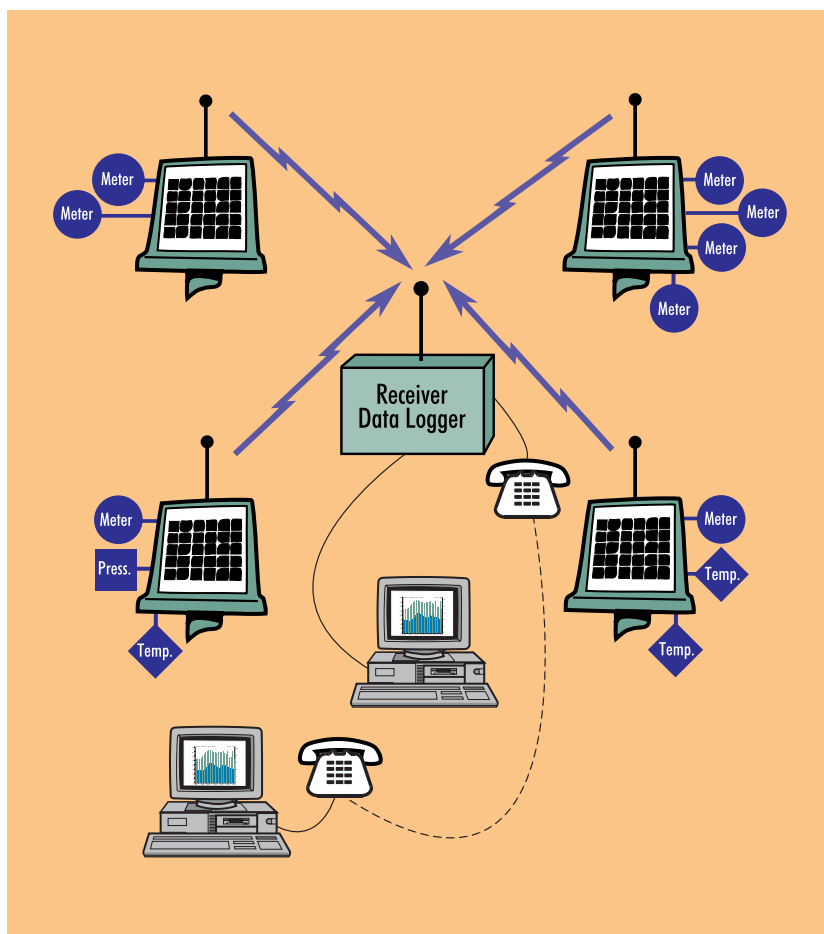


Figure 1 A typical configuration for the DATA BIRD automatic meter-reading system

SYSTEM TESTING

Data Bird was installed at two schools and monitored over a period of six months. The schools experience similar weather patterns, so it was reasonable to assume that they would have comparable energy consumption profiles. The intention was to test the overall reliability and usability of the system.

Three transmitters were installed in both schools at appropriate sites for monitoring gas and electricity consumption. The flexibility of the system allowed mains-operated transmitters to be placed inside the electricity meter cupboard of both schools, with no adverse effect on reception. Receivers were housed within the office at both schools.

A proprietary M&T software programme was used to generate energy profiles for displaying on the PCs at both schools.

Typical results of the energy monitoring are shown in figure 2.

Figure 2 shows the electrical demand profile for school B to be one-third of that for school A. Also the base load for school B is approximately half the demand during school hours. The discrepancies were subsequently investigated and found to be due to:

- higher lighting consumption in school A
- electrical heating left on overnight in school B.

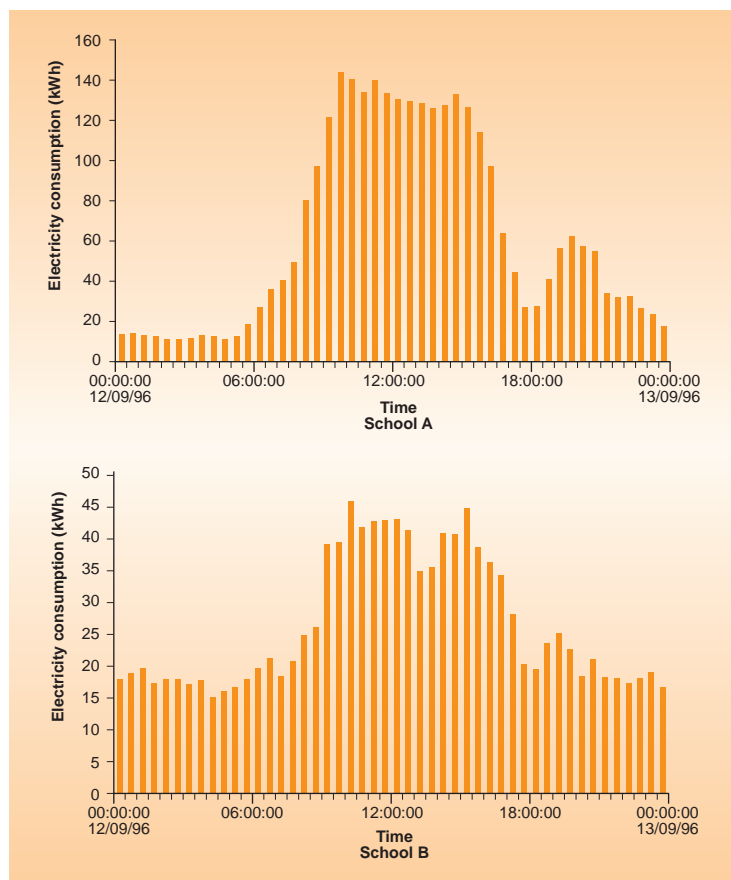


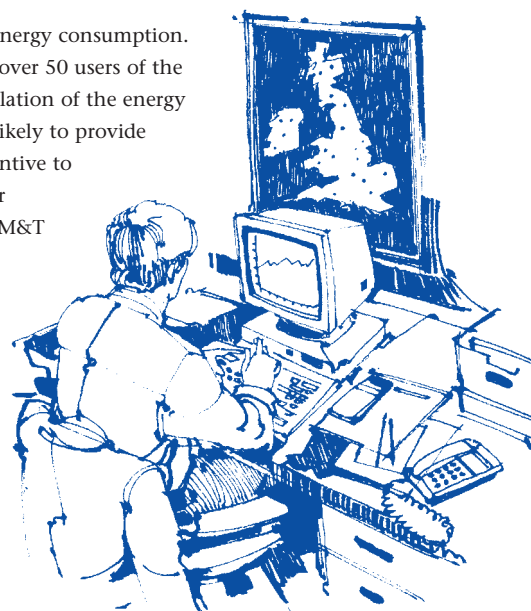
Figure 2 Electricity consumption profiles at two schools

CONCLUSION

By purchasing off-the-shelf components it is possible to develop systems to undertake the automatic reading of meters utilising low-power radio. However, this project demonstrates how this approach has been adopted by a commercial organisation to provide a low-cost approach to automatic M&T, including modifications to proprietary software.

The capital cost of installing the DATA BIRD system on the two schools was less than 10% of the annual fuel costs being monitored. By integrating the system with appropriate software applications, smaller users can realistically benefit

from reduced energy consumption. There are now over 50 users of the system. Deregulation of the energy market is also likely to provide additional incentive to energy users for implementing M&T systems as part of their energy management strategies.



CASE STUDY 1 – LONDON DOCKLANDS DEVELOPMENT CORPORATION



As part of its energy management strategy London Docklands Development Corporation (LDDC) installed the DATA BIRD system to monitor the loads on its existing network. The low-power radio link performed well over the two-mile length of the Royal Docks, sending meter readings to a central receiver and data logger at regular intervals, and also to a second receiver near the centre of the Docks to provide another monitoring location.

The system was first used to reconcile billing errors with London Electricity, which had based its bills on estimated readings. DATA BIRD monitored and logged the actual consumption. This was correlated against degree days^[1], which indicate the rise and fall of local external temperature compared to a national base temperature. The results showed that London Electricity had been estimating winter consumption throughout the year.

DATA BIRD was also used to trace distribution losses, showing that 35% of electricity units recorded were unaccounted for. When the total readings of sub-meters were deducted from the main meter reading there remained a loss of around 60 kW by day, rising to 100 kW at night. The error was found to be due to meter installation faults such as wrongly connected current transformers.

DATA BIRD was also used for energy profiling, so that LDDC's commercial tenants could be charged a 'fair' rate for their electricity. This has resulted in bills being reduced by a total of £35 000 per year. The automatic meter-reading system provided engineers with immediate feedback from all the electricity sub-meters on the site.

CASE STUDY 2 – ROYAL AIR FORCE BASE NEAR BEDFORD

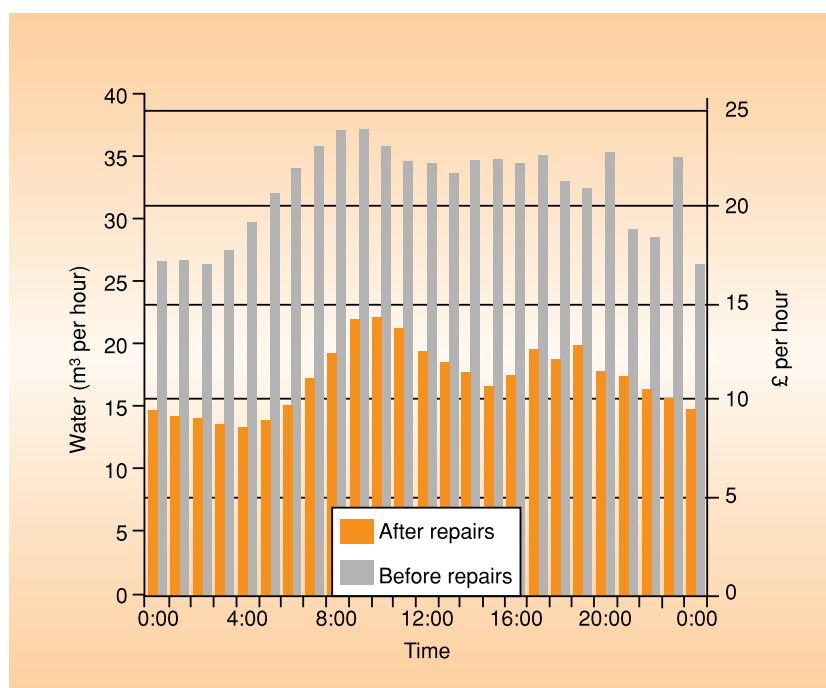


Figure 3 Consumption and savings

Remote monitoring was utilised on two main water meters supplying the RAF base. DATA BIRD identified massive water wastage within 48 hours of its installation.

Night-time consumption showed a usage rate of 27 m³ per hour, indicating leakage equivalent to some £136 000 a year (for water only). Action was taken to locate and repair some leaks and within a short period of time the consumption rate was reduced to 14 m³ per hour, saving £63 000 a year.

Figure 3 shows consumptions and savings.

Due to the success of metering the water to the base, the DATA BIRD system was rapidly extended by adding a further 28 transmitters and approximately 70 electricity and gas sub-meters on the different buildings, to monitor all energy and water consumptions.

FURTHER READING

REFERENCE

[1] Department of the Environment, Transport and the Regions. Fuel Efficiency Booklet 7, 'Degree Days' (FEB 7). DETR, London, 1993.

FURTHER INFORMATION

For further information on the development phase and commercial aspects of DATA BIRD contact: Energy Control Consultants Ltd, Lloyd House 57 High Street, Burnham Slough SL1 7JX Tel 01628 664056

DETR ENERGY EFFICIENCY BEST PRACTICE PROGRAMME DOCUMENTS

The following Best Practice programme publications are available from BRECSU Enquiries Bureau. Contact details are given below.

Introduction to Energy Efficiency

- 2 Catering establishments
- 3 Shops and stores
- 4 Health care buildings
- 7 Sports and recreation centres
- 8 Museums, galleries, libraries and churches
- 9 Hotels
- 10 Post offices, building societies, banks and agencies
- 11 Entertainment buildings
- 12 Prisons, emergency buildings and courts
- 13 Factories and warehouses

Energy Consumption Guides

- 19 Energy use in offices
- 51 Energy efficiency in sports and recreation buildings: a guide for owners and energy managers
- 54 Energy efficiency in further and higher education – cost-effective low energy buildings

- 57 Energy consumption guide for nursing and residential homes

General Information Report

- 12 Organisational aspects of energy management

Good Practice Case Study

- 336 Energy efficiency in further and higher education – Monitoring and targeting. University of Wales, Cardiff

Good Practice Guides

- 186 Developing an effective energy policy
- 200 A strategic approach to energy and environmental management

The following Best Practice programme publications are available from ETSU Enquiries Bureau. Contact details are given below.

General Information Report

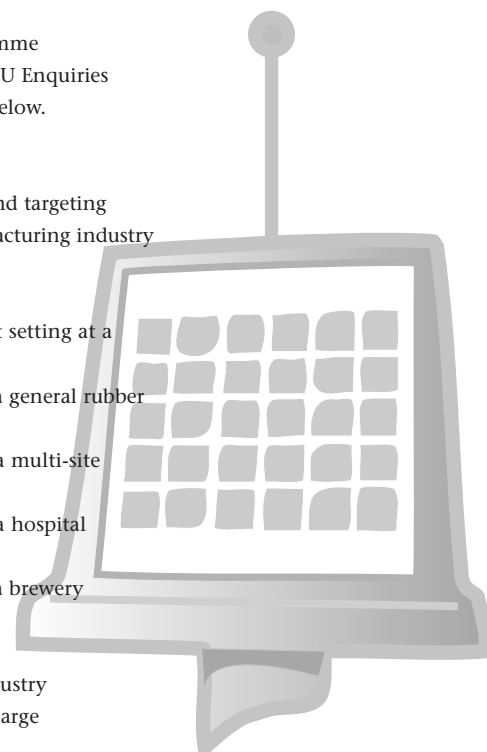
- 19 A review of the monitoring and targeting programme in the UK manufacturing industry

Good Practice Case Studies

- 138 Energy monitoring and target setting at a dairy
- 142 Monitoring and targeting at a general rubber goods site
- 207 Monitoring and targeting in a multi-site company
- 221 Monitoring and targeting in a hospital laundry
- 273 Monitoring and targeting at a brewery

Good Practice Guides

- 31 Computer aided M&T for industry
- 91 Monitoring and targeting in large manufacturing companies



The Government's Energy Efficiency Best Practice programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings. This information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Visit the website at www.energy-efficiency.gov.uk

For further information on:

Buildings-related projects contact:
Enquiries Bureau

BRECSU

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Fax 01923 664787
E-mail brecsuenq@bre.co.uk

Industrial projects contact:
Energy Efficiency Enquiries Bureau

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Tel 01235 436747
Fax 01235 433066
E-mail etsuenq@deat.co.uk

Energy Consumption Guides: compare energy use in specific processes, operations, plant and building types.

Good Practice: promotes proven energy-efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R&D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Introduction to Energy Efficiency: helps new energy managers understand the use and costs of heating, lighting, etc.